

-15-

AHBC4043

What is claimed is:

1           1.     A layered tubing for use in a motor  
2     vehicle, the tubing comprising:  
3           a thick flexible outer tubing having an inner  
4     and an outer face, the outer tubing consisting  
5     essentially of an extrudable thermoplastic 6-carbon block  
6     polyamide having an elongation value of at least 150% and  
7     an ability to withstand impacts of at least 2 ft/lbs at  
8     temperatures below about -20°C;  
9           a thin intermediate bonding layer bonded to the  
10    inner face of the thick outer layer, the bonding layer  
11    consisting essentially of an extrudable melt processible  
12    thermoplastic capable of sufficiently permanent laminar  
13    adhesion to the inner face of the outer tubing; and  
14           an inner barrier layer bonded to the  
15    intermediate bonding layer, the inner layer consisting of  
16    an extrudable, melt-processible thermoplastic capable of  
17    sufficiently permanent laminar adhesion with the  
18    intermediate bonding layer, the inner layer consisting  
19    essentially of an extrudable thermoplastic 6-carbon block  
20    polyamide having an elongation value of at least 150% and  
21    an ability to withstand impacts of at least 2 ft/lbs at  
22    temperatures below about -20°C.

1           2.     The tubing of claim 1 wherein the inner  
2     hydrocarbon barrier layer is capable of dissipating  
3     electrostatic energy, the electrostatic dissipation  
4     capacity being in a range between about  $10^{-4}$  to  $10^{-9}$   
5     ohm/cm<sup>2</sup>.

1           3.     The tubing of claim 1 wherein the inner  
2     hydrocarbon layer contains quantities of a conductive  
3     material sufficient to provide electrostatic dissipation  
4     capability in a range between about  $10^{-4}$  to  $10^{-9}$  ohm/cm<sup>2</sup>.

-16-

AHBC4043

1           4. The tubing of claim 3 wherein the  
2     conductive material is selected from the group consisting  
3     of elemental carbon, copper, silver, gold, nickel,  
4     silicon, and mixtures thereof.

1           5. The tubing of claim 4 wherein the  
2     conductive material is present in an amount less than  
3     about 5% by volume of the polymeric material.

1           6. The tubing of claim 1 wherein the  
2     extrudable thermoplastic polyamide of the thick outer  
3     layer is a derived by the condensation polymerization of  
4     caprolactam.

1           7. The tubing of claim 6 wherein the  
2     extrudable thermoplastic polyamide of the thick outer  
3     layer consists essentially of Nylon 6 and additive  
4     materials present in sufficient quantities to impart  
5     resistance to exposure to zinc chloride.

1           8. The tubing of claim 7 wherein the thick  
2     outer layer is essentially non-reactive after 200 hour  
3     immersion in a 50% by weight aqueous zinc chloride  
4     solution.

1           9. The tubing of claim 1 wherein the  
2     thermoplastic material employed in the intermediate  
3     bonding layer exhibits at least some resistance to  
4     interaction with short-chain hydrocarbon molecules  
5     present in material conveyed through the tubing.

1           10. The tubing of claim 9 wherein the  
2     thermoplastic material employed in the intermediate  
3     bonding layer includes as a major constituent an  
4     extrudable, melt processible thermoplastic selected from  
5     the group consisting of co-polymers of alkenes having  
6     less than four carbon atoms and vinyl alcohol, copolymers

-17-

AHBC4043

7 of alkenes having less than four carbon atoms and vinyl  
8 acetate, and mixtures thereof.

1 11. The tubing of claim 1 wherein the inner  
2 layer consists essentially of a thermoplastic selected  
3 from the group consisting of extrudable melt processible  
4 polyamides derived from condensation polymerization of  
5 caprolactam.

1 12. The tubing of claim 1 further comprising  
2 an exterior jacket overlying the thick outer tubing, the  
3 exterior jacket composed of a material consisting  
4 essentially of a thermoplastic rubber selected from the  
5 group consisting of Nylon 11, Nylon 12, zinc chloride  
6 resistant Nylon 6, Santoprene, Kraton, Vichem, Sarlink  
7 and mixtures thereof.

1 13. A layered tubing for use in a motor  
2 vehicle, the tubing being resistant to hydrocarbon  
3 emissions, the tubing comprising:  
4 an outer tubing having an inner and an outer  
5 face, the outer tubing consisting essentially of an  
6 extrudable melt processible 6-carbon block polyamide  
7 having an elongation value of at least 150% and an  
8 ability to withstand impacts of at least 2 ft/lbs at  
9 temperatures below about -20°C, the 6-carbon block  
10 polyamide being essentially non-reactive with zinc  
11 chloride;  
12 an intermediate bonding layer having a  
13 thickness between about 0.01 mm and about 0.2 mm bonded  
14 to the inner face of the thick outer layer, the bonding  
15 layer consisting essentially of an extrudable  
16 thermoplastic capable of sufficiently permanent laminar  
17 adhesion to the polyamide outer tubing and exhibiting at  
18 least some resistance to short-chain hydrocarbon  
19 molecules conveyed through the tubing; and

-18-

AHBC4043

20 an inner layer bonded to the intermediate  
21 bonding layer having a thickness between about 0.01 mm  
22 and about 0.2 mm, the inner layer consisting essentially  
23 of an extrudable, melt processible thermoplastic capable  
24 of sufficiently permanent laminar adhesion with the  
25 intermediate bonding layer, the inner layer consisting  
26 essentially of an extrudable thermoplastic 6-carbon block  
27 polyamide having an elongation value of at least 150% and  
28 an ability to withstand impacts of at least 2 ft/lbs at  
29 temperatures below about -20°C.

1 14. The tubing of claim 13 wherein the reduced  
2 hydrocarbon emission rate is less than about 0.5g/m<sup>2</sup> per  
3 24 hour interval.

1 15. The tubing of claim 13 further comprising  
2 an exterior jacket overlying the thick outer tubing, the  
3 exterior jacket composed of a material consisting  
4 essentially of a thermoplastic rubber selected from the  
5 group consisting of Nylon 11, Nylon 12, zinc chloride  
6 resistant Nylon 6, Santoprene, Kraton, Vichem, Sarlink,  
7 polypropylene and mixtures thereof.